MATURATION AND SPAWNING OF *RASBORA DANICONIUS* (HAM.-BUCH.)[1]

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(*With two text-figures*)

The present paper deals with the study on the gonadal maturation, sex ratio, minimum size at maturity, spawning season and spawning periodicity in a cyprinid fish, *Rasbora daniconius*.

Introduction

The maturation and spawning study is important as a factor with significant correlations with other biological activities, since this study is useful in various applied aspects of fishery, its management and industries.

Oviparous fishes exhibit various types of spawning tendencies which can be studied from the development of the intra-ovarian eggs. Walford (1932), Clark (1934), and Hickling & Rutenberg (1936) studied various spawning behaviours based on the size distribution of the intra-ovarian eggs in different fishes.

Material and methods

3085 specimens of *Rasbora daniconius* were collected from August 1973 to July 1974 from river Kham near Aurangabad. The total length and weight of each fish were accurately measured in mm and mg respectively and the lengths and weights of the gonads were also noted. The ovaries were then preserved in 5% formalin for ova-diameter measurements of the intra-ovarian eggs. Since the distribution of ova in anterior, middle and posterior regions was uniform, the ova-diameter measurements from only the middle region of each ovary were taken. The range of ova in each ovary was then divided into several groups with a class interval of three micrometer divisions and the percentage of the ova present in each size group was calculated and presented in graphs (Figs. 1 & 2).

Growth of ova in different stages of maturity : The ova-diameter frequency polygons exhibited in Fig. 1, show size distribution of ova in the ovaries of different stages of maturity. On the basis of the gonadal appearance, the size of the intra-ovarian eggs and the extent of the yolk present in the ova, the ovaries have been classified into seven maturity stages (Wood 1930). Stage V again has been sub-classified into V_1, V_2 and V_3 sub-stages on the basis of the modes shown by the ovaries in stage V.

Sex ratio : Sex composition for different months and different size groups is shown in Tables 1 and 2 respectively. The Chi-square test (Snedecor 1961), used in each case confirms whether the observed ratio agrees to the expected 1 : 1 ratio between the two sexes. The X^2 values significant at 5% level are shown with one asterisk and those significant at both 5% and 1% levels are shown with two asterisks.

Minimum size at maturity : 2152 females specimens ranging between 36 and 160 mm in total length were examined for their maturity stages. The number and percentage of females in different maturity states, such as immature, maturing, mature and spent were recorded

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TABLE 1

SEX COMPOSITION AND ITS CHI-SQUARE TEST FOR DIFFERENT MONTHS IN *R. daniconius*

Months	Total No. of specimens examined	Females		Males		X^2	D.F.
		Number	Percentage	Number	Percentage		
1973							
August ..	192	155	80.73	37	19.27	72.5**	1
September ..	559	322	57.60	237	42.40	12.925**	1
October ..	320	173	54.06	147	45.94	2.113	1
November ..	268	178	66.42	90	33.58	29.895**	1
December ..	372	272	73.12	100	26.88	79.527**	1
1974							
January ..	311	262	84.24	49	15.76	145.881**	1
February ..	238	197	82.77	41	17.23	102.252**	1
March ..	188	136	72.34	52	27.66	37.531**	1
April ..	201	131	65.17	70	34.83	18.512**	1
May ..	93	75	80.65	18	19.35	34.936**	1
June ..	137	100	72.99	37	27.01	28.971**	1
July ..	206	151	73.30	55	26.70	44.738**	1
Pooled ..	3,085	2,152	69.76	933	30.24	481.673**	1

TABLE 2

SEX COMPOSITION AND ITS CHI-SQUARE TEST FOR DIFFERENT 10 MM SIZE GROUPS IN *R. daniconius*

Length groups in mm.	Total No. of specimens examined	Females		Males		X^2	D.F.
		Number	Percentage	Number	Percentage		
36-45 ..	235	135	57.45	100	42.55	5.213*	1
46-55 ..	371	212	57.14	159	42.86	7.571**	1
56-65 ..	349	213	61.03	136	38.97	16.989**	1
66-75 ..	604	373	61.75	231	38.25	33.384**	1
76-85 ..	550	362	65.82	188	34.18	55.047**	1
86-95 ..	486	431	88.68	55	11.32	290.897**	1
96-105 ..	268	241	89.93	27	10.07	170.881**	1
106-115 ..	104	83	79.81	21	20.19	36.962**	1
116-125 ..	55	39	70.91	16	29.09	9.618**	
126-135 ..	35	35	100.00	..	..	..	..
136-145 ..	19	19	100.00	..	..	..	..
146-155 ..	7	7	100.00	..	..	..	..
156-165 ..	2	2	100.00	..	..	..	..
Pooled ..	3,085	2,152	69.76	933	30.24	481.673**	1

for each size group as shown in Table 3. The Table indicates that mature females appear for the first time in 66-75 mm size group in 4.29%. In the next size group 76-85 mm these females occur in 22.1%. As the percentage 4.29 in the 66-75 mm size group is too insignificant, the minimum size of maturity can be fixed between 76 and 85 mm or 80 mm, the average size of the length group. The occurrence of spent females in the same size group may be due to the wide range of the size group.

Spawning season : Out of 2152 females examined during one year, only 1219 females—all above the minimum size of maturity (i.e. above 75 mm total length), were taken into consideration in this observation. The data of 1219 females collected in different months were analysed into different maturity stages as represented in Table 4. The Table indicates total absence of ripe females in May and their presence from June to November. The small percentage (4.23) of spent females in June may be due to spawners shedding their eggs in early June. In November only two ripe females (4.65%) were caught and there was total absence of spent females in December. This

TABLE 3

PERCENTAGE DISTRIBUTION OF IMMATURE, MATURING, MATURE AND SPENT SPECIMENS IN EACH 10 MM SIZE GROUP

Length groups in mm.	No. of females examined	Immature No. and %	Maturing No. and %	Mature No. and %	Spent No. %
36-45 ..	135	135 (100.00)	..	..	..
46-55 ..	212	166 (78.30)	46 (21.70)	..	..
56-65 ..	213	136 (63.85)	77 (36.15)	..	..
66-75 ..	373	224 (60.05)	133 (35.66)	16 (4.29)	..
76-85 ..	362	179 (49.44)	54 (14.91)	80 (22.10)	49 (13.54)
86-95 ..	431	159 (36.89)	82 (19.03)	122 (28.30)	68 (15.78)
96-105 ..	241	54 (22.41)	73 (30.29)	74 (30.71)	50 (16.60)
106-115 ..	83	13 (15.66)	25 (30.12)	30 (36.14)	15 (18.07)
116-125 ..	39	2 (5.13)	12 (30.77)	16 (41.03)	9 (23.08)
126-135 ..	35	1 (2.86)	7 (20.00)	17 (48.57)	10 (28.57)
136-145 ..	19	..	2 (10.52)	11 (57.90)	6 (31.58)
146-155 ..	7	..	..	5 (71.43)	2 (28.57)
156-165 ..	2	..	..	2 (100.00)	..

(Figures in brackets indicate percentage)

TABLE 4

NUMBER AND PERCENTAGE OF FEMALES (ABOVE 75 MM TOTAL LENGTH) IN DIFFERENT STAGES OF MATURITY

Month	Total No. of females examined	I	II	III	IV	V	VI	VII
1973								
August ..	122	..	..	..	1 (0.82)	38 (31.15)	45 (36.89)	38 (31.15)
September ..	122	..	..	..	1 (0.82)	28 (22.95)	49 (40.16)	44 (36.07)
October ..	105	12 (11.43)	..	..	..	11 (10.48)	36 (34.29)	46 (43.81)
November ..	43	20 (46.51)	..	..	..	..	2 (4.65)	21 (48.84)
December ..	112	76 (67.86)	36 (32.14)	..	..	..	..	..
1974								
January ..	130	7 (5.38)	112 (86.15)	11 (8.46)	..	..	..	..
February ..	120	..	84 (70.00)	35 (29.17)	1 (0.83)	..	..	..
March ..	107	..	39 (36.45)	59 (55.14)	9 (8.41)	..	..	..
April ..	78	..	16 (20.51)	30 (38.46)	27 (34.62)	5 (6.41)	..	..
May ..	64	..	6 (9.38)	21 (32.81)	23 (35.94)	14 (21.88)	..	..
June ..	71	..	..	4 (5.63)	26 (36.62)	16 (22.54)	22 (30.99)	3 (4.23)
July ..	145	..	..	..	7 (4.83)	43 (29.66)	48 (33.10)	47 (32.41)

(Figures in brackets indicate percentages)

suggests that there was no spawning in November, the two ripe females thereat belonged to the late spawners. The data, therefore, indicate that *R. daniconius* spawns from early June to late October, lasting for a period of five months.

Spawning periodicity: Ova-diameter measurement method was adopted for this purpose. Mature ovaries in Vth and VIth stages were obtained from mature females collected in breeding season and fixed in 5% formalin. Eleven such ovaries were selected and the ova-diameter measurements from the middle region of each of the ovaries were taken. From the number of ova and their percentage in each ova-diameter size group, frequency distribution graph for each of the ovaries was drawn as shown in Fig. 2.

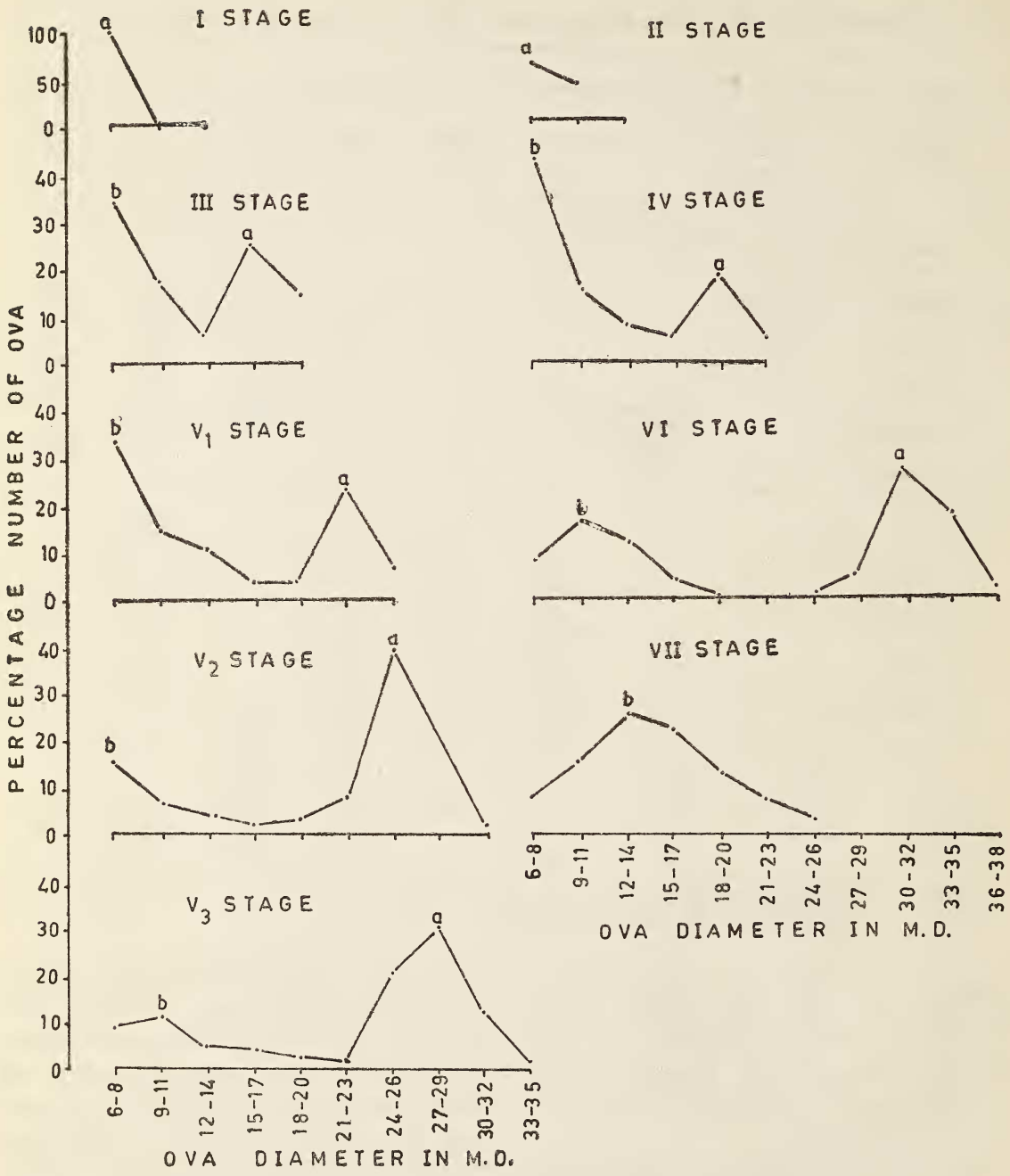

Fig. 1. Ova-diameter frequency polygons showing the growth of the ova in different stages of maturity.

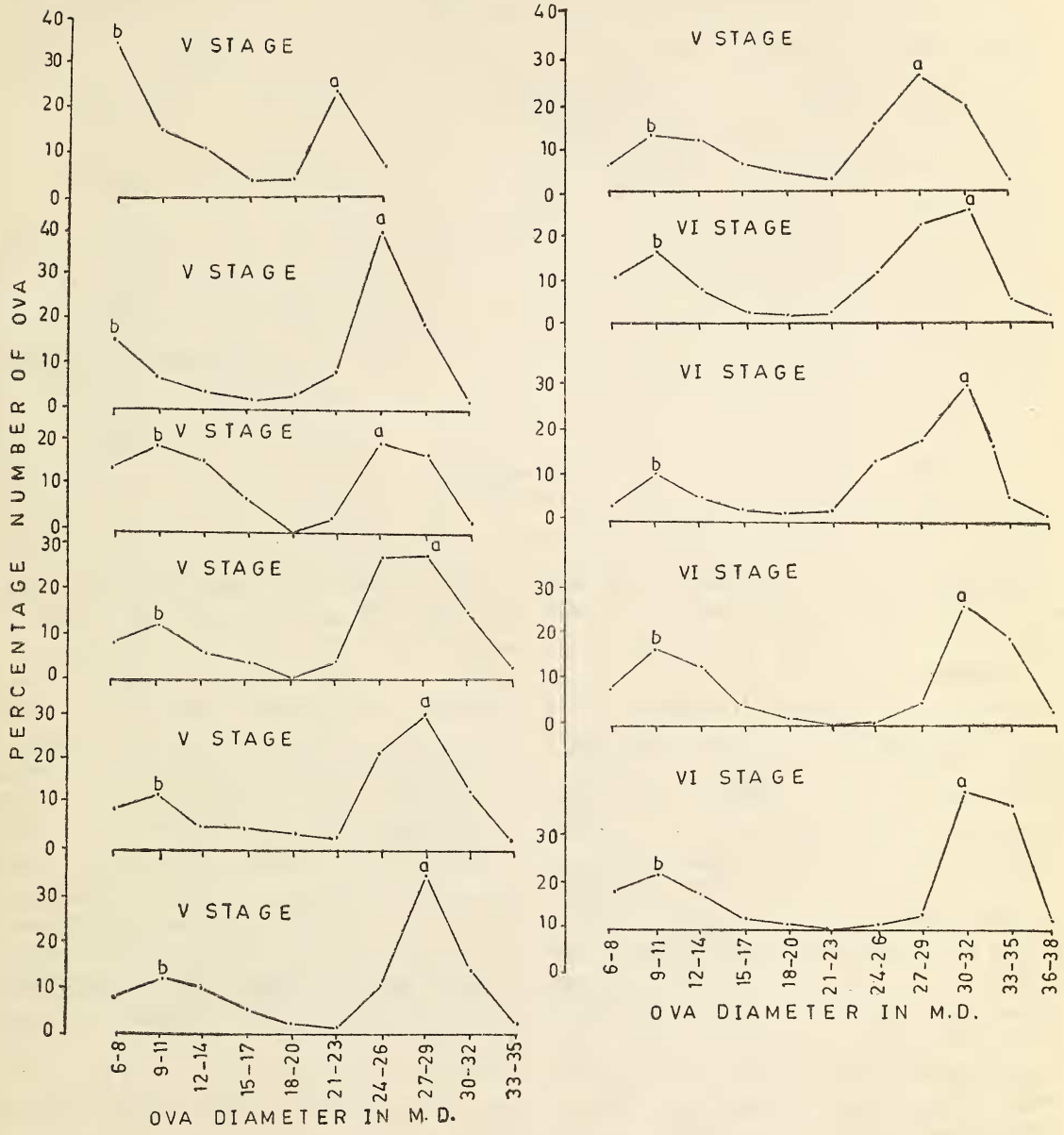

Fig. 2. Size frequency distribution of ova in mature ovaries (Stages V and VI) of *Rasbora daniconius*.

TABLE 5

SHOWING DETAILS OF OVA-DIAMETER RANGE, MODAL TYPES AND MODAL SIZES OF OVA IN EACH MATURITY STAGE OF THE OVARY

Stage of maturiy		Range of ova diameter in m.d.	Modal type	Modal size of ova in m.d.
I	..	6-8	'a'	(6-8)
II	..	6-11	'a'	(6-8)
III	..	6-20	'a'	(15-17)
	..		'b'	(6-8)
IV	..	6-23	'a'	(18-20)
	..		'b'	(6-8)
V	..	6-35	'a'	(21-23),(24-26),(27-29)
	..		'b'	(6-8), (9-11)
VI	..	6-38	'a'	(30-32)
	..		'b'	(9-11)
VII	..	Shortened and indefinite	..	..

It is clear from Fig. 2 that each of the ova-diameter frequency polygons has two distinct modes, 'b' and 'a', the former representing the immature egg stock and the latter the mature ones. Walford (1932) observed that in a fish spawning once in a year, the mature ovary contains only two types of ova, the immature and the mature. Hence from the above observation it can be said that the fish spawns only once in a year. From Table 5 and Fig. 2 it is clear that the total range of the distribution of intra-ovarian eggs in *R. daniconius* is from 6 to 38 m.d., out of which the mature ova cover a range of 18 to 38 m.d., which is nearly half of the total range of the distribution of the intra-ovarian eggs, thereby indicating a prolonged breeding season of the species (Prabhu 1956). The fact that the mature ova are clearly differentiated from the immature ones indicates that the fish spawns in a definite spawning season (Hickling & Rutenberg 1936, De Jong 1939).

It is observed from Table 5 and Fig. 2 that the range of mature ova in the ovaries in stages V and VI is very wide. In the ovaries in Vth stage the mature ova ranged from 18-35 m.d., while those in stage VI ranged from 18-38 m.d. This shows that from Stage V to VI the ova grow from 35 to 38 m.d., i.e. 3 m.d. in diameter. The maximum size of the ova in the ovaries in Stage IV is 23 m.d. This indicates that the mature ova in stage V grow from 23 to 35 m.d., i.e. 12 m.d. in diameter, thus showing that the ovary in stage V grows through a wide range of size and also progresses through different modes showing differential maturity as shown by the sub-stages V_1, V_2 and V_3. The sub-stage V_3 can be said to be more advanced when compared to other two. The phenomenon deals with the prolonged breeding habits of the fish.

It is also clear from the above observations that in stage VI the growth of ova is only 3 m.d. in diameter, whereas, in stage V it is 12 m.d.

in diameter, indicating that the growth of the ova in stage VI is less than that in the stage V and also that the ova after attaining stage VI spawn immediately within a short duration. From this observation it can also be concluded that the ova in stage V have longer persistence in the ovary than those in stage VI.

Results and discussion

The sex ratio in different months and size groups showed dominance of one sex, the females. The Chi-square tests proved that in none of the cases except in October, the sex ratio agreed to the expected 1 : 1 ratio. Since the fish spawns in October, the above observation closely agreed with the view of Tandon (1961), who found that *Selaroides leptolepis* congregated in almost equal numbers during spawning season. The minimum size of maturity was found to be between 76 and 85 mm in total length. The spawning season extended from early June to late October, exhibiting a prolonged duration of spawning periodicity in a single spawning season.

The ovaries of *R. daniconius* were classified into seven maturity stages on the basis of ova-diameter and degree of yolk content in ova. In ova-diameter distribution graphs the mode ' a ' of mature ova showed only one constant position in each of the stages except in stage V, where it showed three different positions which formed the basis to sub-classify the ovaries in stage V as V_1, V_2 and V_3, showing gradation in the maturity in one stage itself. Formation of these sub-stages in the stage V could be attributed to the wide range of ova diameter progressed in the stage. The above observation also formed the basis to find out the prolonged spawning periodicity in the fish.

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